Using 95% UCLs in Human Health Risk Assessments

Introduction

Human health risk assessments at Superfund sites determine if contaminant concentrations in soil, water or air warrant further attention to reduce potential health risks.

Sampling provides information about contaminant locations and their concentrations in each media (soil, water and air). Sampling is always a snapshot of contaminant concentrations at a specific location and time. Sampling results are used to build a conceptual model of where contaminants are, how they have moved and how they could continue to move in the environment.

Sampling results are often analyzed statistically to create a more complete picture of contaminants' likely locations and concentrations. One method of predicting concentrations is called the 95% Upper Confidence Limit of the Mean (95% UCL). The 95% UCL is often used to represent the exposure concentrations associated with pollutants found at Superfund sites. In fact, 95% UCLs are the standard way of representing exposure concentrations in the environmental field. This fact sheet explains what a 95% UCL is and how it is used.

Description of the 95% UCL

The technical definition of a 95% UCL is "a number that one can be 95% confident that the true mean (average) concentration of the population is below that value." Using a 95% UCL to make risk calculations gives us more confidence in the health protectiveness of our calculations.

Why Use 95% UCLs?

It may seem that the average contaminant concentration calculated from all of the samples taken would be the best scientific estimate of the exposure concentration of a pollutant. If we were concerned only with the average concentration from the specific sampling locations, the average could be the best value to use. However, we want to know the average concentration for *an entire designated area*. Since there are a limited number of samples, we do not have direct information about the concentrations of pollutants at other locations within the designated area.

Imagine two sets of soil sample results. Both sets of samples are from the same designated area at a Superfund site. Is one set of numbers better than the other? Probably not – they are just two different sample sets from the same "population" of possible sample locations. A 95% UCL takes into account that information about all possible sampling locations is not available and makes a conservative (i.e., health protective) estimate of the true concentration over all possible sampling locations.

How Are 95% UCLs Calculated?

There are many different ways to calculate UCLs. They all require two main pieces of information: a value that represents the "middle" of the data and a number that represents how "spread out" the data are. A UCL starts with the middle number and then looks at how spread out the data are to determine how much needs to be added to be adequately conservative. For example, consider the two sets of numbers below:

Set # 1											
1	2	2	4	6	6	12	15	16	17	18	21
Set # 2											
7	8	8	9	9	10	10	11	11	12	12	13

Both sets of numbers have an average of ten (10). However, Set #1 is much more spread out than Set #2, as shown in Figure 1. A 95% UCL calculated from Set #1 would be larger (we would have to add more to the average) than a UCL calculated from Set #2 for us to be 95% confident that the average concentration of all possible samples is below that value. Figure 1 shows the 95% UCLs for each set of numbers.

What Do 95% UCLs Mean?

Using 95% UCLs adds confidence that the values used in risk assessments are health protective. It means EPA is 95% confident that the value used to make risk calculations is greater than the true mean (average) of contaminant concentrations for all possible samples in the designated area.

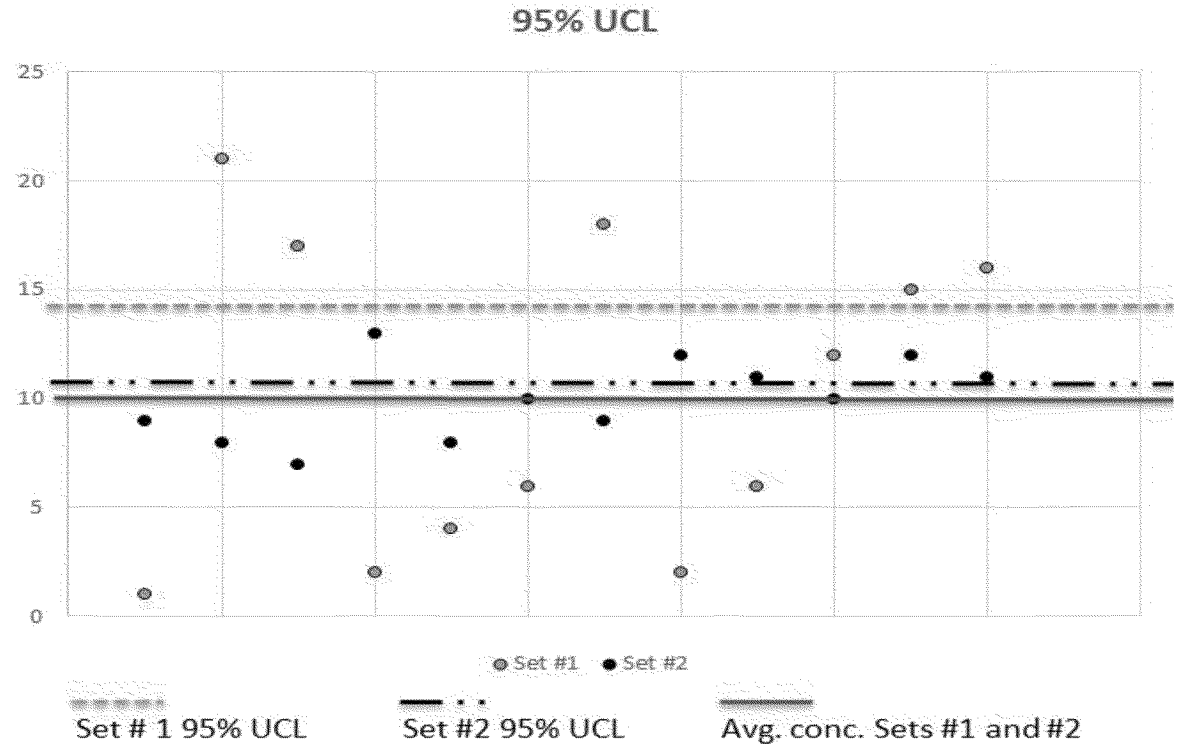

Figure 1. The 95% UCLs for Two Sets of Numbers